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THE USE OF MANURE AS A SUMMER MULCH IN VEGETABLE FORCING HOUSES.

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It is a common practice among those engaged in forcing vegetables under glass, in case the soil in the beds is not renewed, to allow it to become very dry during that portion of the season when the houses are not in use. No water is applied and as the temperature often rises above 100 degrees Fahr. the soil loses nearly all of its moisture during the two or three months when no crops are grown.

One reason for following this method is that it is convenient, as it requires no expenditure of labor. Some believe that the drying out of the soil in this manner has beneficial effect in preventing diseases which effect the lettuce crop.

Prof. Geo. E. Stone, Botanist of the Massachusetts Agricultural College and Experiment Station, has made and reported some experiments which throw light upon the question of the effect, upon subsequent crops, of desiccation or drying of greenhouse soils.

In his report for 1902, Prof. Stone has the following to say as to "The Effect of Desiccation on Soils". "The practice of desiccation or drying greenhouse soil by the aid of the heat of the summer sun has been in vogue with us for some time, for the purpose of observing what effect such treatment would have on certain organisms. We have already shown* that the Sclerotinia or the Drop fungus when dried is greatly accelerated in its activity, which increases to a great extent the amount of infection in the succeeding crop of lettuce."

"There are other effects of drying on the soil which prove very destructive to the development of lettuce plants, although we have not observed this effect on other species. On lettuce we have observed this repeatedly, and the characteristic results of such drying are manifested in a stunted growth and abnormally colored and worthless crop. The crop scarcely ever attains more than one-third of its size. The texture of the plant is poor, being thick and tough,

*Prof. Stone refers here to a test reported in September, 1900, Bul. 69, Hatch Experiment Station. "In this test the house was closed during the greater part of August, September and October, at which time the soil was subject to the intense rays of the sun which heated the soil up to a temperature of 123 degrees Fahr. and the air thermometer registered 140 degrees Fahr. As the top layer of the soil became dry a lower layer to the depth of a foot was forked over two or three times, so that practically the whole amount of soil became desiccated. The result of drying out of the soil in one bed containing 308 plants was that 235, or 76 percent, were subject to Drop, and 66, or 21 percent, to Rhizoctonia. The number of plants which succumbed to the two diseases was 301 out of a total of 308, or 97 per cent. The other half of the house containing 264 plants, was treated similarly, with about the same result.

and inclined to crinkle. That this is caused by desiccation alone is shown by the fact that wherever any drip from the roof fell upon the soil during the summer rains, the plants growing in such places were always normal. Distinctly sharp lines can be observed in a lettuce crop grown under such conditions, owing to the difference in development brought out by desiccation and the presence of a small amount of water due to dripping. Instances have come to our notice where large houses devoted to lettuce have been allowed to become quite dry, with the same result on the crop as noted above. The remedy for this trouble is obvious: namely, not to allow the house to become too dry in summer, but to keep the soil more or less supplied with water. If such drying occurs, the soil can be entirely renovated by applying hot water or steam to it.

Three years ago the Ohio Station began an experiment to see what effect the use of strawy manure would have on the soil when used as a mulch during that part of the summer when crops are not growing in the greenhouses. This manure was applied as soon as the tomato and cucumber vines were removed from the houses, or about the first of August. It was put on to a depth of from five to six inches and spread evenly over the entire surface of the beds. As soon as it was on, water was applied in the form of a spray until the manure and soil were thoroughly wet.

The object of this wetting was first to leach the fertility of the manure into the soil and second to wet the soil sufficiently so that with the strawy mulch it would remain moist for several days. The operation of watering was repeated as often as needed; two or three times a week in bright weather.

When it came time to plant the lettuce, about the middle of September, the coarse part of the manure was removed from the beds and carried outside. The finer portion of the manure was worked into the soil at the time of spading.

It was noticable that the soil which had been treated with the mulch was in excellent mechanical condition when it was worked up for the first crop. There were no lumps, as there often are in soil which has been allowed to bake in the sun for weeks at a time. It was also darker in color than unmulched soil. The lettuce plants which were planted in this soil started off nicely and grew rapidly and satisfactorily in every respect. No further application of manure or fertilizer of any kind was made for the second and third crops of lettuce. The growth of these crops was very satisfactory, as was that of the first crop. Liquid manure was applied to the tomato plants when the fruit began to ripen. This fertility might have been applied in the form of manure as a mulch and probably it is best to apply it in that way rather than in liquid form.

This method of treating the soil during the summer gave such favorable results the first season it was tried that the Station induced several practical greenhouse men to try it last season (1906). The junior author of this circular has kept in touch with many of the larger vegetable forcing establishments throughout the state during the past year or more by making frequent visits to their greenhouses.

One firm, the Miller Bros., of Toledo, Ohio, began the use of the summer mulch the same season the Station began it, neither party knowing that the other was trying this method of soil treatment. They have continued this practice and are well pleased with the results.

Some of the parties who promised to make a test of the use of manure as a summer mulch were unable to do so for various reasons. Of those who tried it some did not apply water frequently enough, thus allowing the soil to become dry and destroying the value of the test. Others grew tomatoes as a fall crop on the mulched area and lettuce on the unmulched area, thus preventing a fair comparison. Still others mulched all of their soil, not leaving any without mulch for comparison. In one case where a careful mulch test was made other conditions entered in in such a way that safe conclusions could not be drawn.

Taking the results of the Station tests for the two seasons, together with the results secured by the Miller Bros. for the same length of time and gleaning what information it has been possible to obtain from various sources, the Station does not hesitate to recommend this treatment for soils which are to be used for vegetable forcing. It must be borne in mind, however, that no half-way or slipshod methods of using the mulch will give satisfactory results. There should be sufficient fertility in the manure to furnish enough plant food, when leached into the soil, to supply the three crops of lettuce. The quantity of manure must be sufficient, also. At least five or six inches should be applied. A considerable quantity of coarse material in the manure, such as straw, corn stover, etc., is an advantage. Fresh manure has been used at the Station each time, and, while we have had no chance to see the effect of the use of the well rotted manure, we are satisfied with fresh manure, as we know that it will give good results.

Where it is the practice to mulch the cucumber or tomato crop the manure used for that purpose can be left on and more added, provided the cucumbers or tomatoes have been free from disease. In case these crops have been diseased, it would be advisable to remove the mulch used on them and apply new.

Frequent sprinkling of the manure on the beds is very essential, and where the Skinner or some other mechanical system is in use this can be done thoroughly and with the expenditure of little

time and labor. Where it is necessary to water by hand it will be harder to get the work done, but it must not be neglected, as failure is sure to follow the lack of application of sufficient water to properly leach the fertility of the manure in the soil, and to keep it moist.

When it comes time to put in the first crop, if the soil is in need of humus the entire mulch may be spaded into the soil, but most greenhouse soils do not need the addition of so much coarse material. Where the soil is fairly well supplied with humus the coarser part should be taken off and removed from the houses and the finer portion worked into the soil.

We are not prepared to say what effect the use of the summer mulch may have on the diseases affecting lettuce, except that the Station greenhouses have been very free from all diseases of lettuce since we have been using this method of treating the soil. The Miller Bros.' lettuce crops have also been practically exempt from these diseases during the two years they have been mulching. In no case where the mulch has been used have we observed an increase in the number of diseased plants over an equal area not mulched. These facts, taken together with results secured by Prof. Stone and reported in this circular, would lead us to expect beneficial rather than detrimental results from the proper use of summer mulch, so in far as it affects the diseases of lettuce. The theory which Prof. Stone advances is that when the soil is allowed to dry out the organisms in the soil take on a resting stage and then when the soil is made wet at the time of putting out the first lettuce crop they become very active. If, on the other hand, the soil is kept moist, the organisms do not go into a resting stage and are about as active at one time as another. In the latter case they are not nearly so active when the crop is growing as in the former.

It will be seen from this that if the summer mulch has any beneficial effect in controlling or preventing lettuce diseases it is entirely a preventive measure and not a cure.

This method or any other one, however, will not overcome or prevent damage which results from bad methods of handling the crop. For example, poor ventilation is responsible for a good deal of the loss from lettuce drop. No matter what care may be taken in the preparation of the soil, if the ventilation is faulty, bad results are sure to follow. Then, too, some growers persist in the use of lank, overgrown plants. This practice is responsible for more or less loss each year. In some cases not enough water is applied and in others it is applied too freely and at the wrong time. Other faulty practices might be mentioned, but these are sufficient to show that no matter how much care may be exercised along some lines if, through carelessness or lack of knowledge, other important things are neglected, the result will be anything but satisfactory.